AMENDMENTS TO THE CLAIMS

The following listing of claims will replace all prior versions and listings of claims in the application.

LISTING OF CLAIMS

1.   (Currently Amended) An optical network comprising:

sections for establishing optical paths using Open Shortest Path First-Traffic Engineering (OSPF-TE) as a routing protocol and Resource reSerVation Protocol-Traffic Engineering (RSVP-TE) as a signaling protocol, for Generalized Multi-Protocol Label Switching (GMPLS);

a plurality of optical edge routers for connecting external IP networks to the optical network; and

a plurality of optical cross connects, for connecting the optical edge routers by the optical paths, having switching sections with respect to an optical pulse unit, wherein

each of the optical edge routers has both of:

an optical network control instance for maintaining topology information in the optical network and switching/signaling the optical paths; and

an IP network instance for maintaining a routing table in each of the external IP networks and activating routing protocols between the external IP networks and the IP network instance.

2.   (Original) An optical network according to Claim 1 wherein the routing protocols for exchanging route information among the external IP networks are

activated among the optical network control instances in the edge routers to which the external IP networks are connected.

    3.   (Currently Amended) An optical network according to Claim 1 or 2, wherein Border Gateway Protocols (BGPs) [[BGPs]] are used for protocols for exchanging the route information of the external IP networks.

    4.   (Currently Amended) An optical edge router, used for an optical network, for transmitting packets between external IP networks and the optical edge router, comprising:

        a section for transmitting the packets between neighboring routers in neighboring external IP networks;

        a section for exchanging route information between the neighboring routers;

        a section for producing a routing table and storing the produced routing table in a storage section;

        a section for collecting topology information existing in the optical network and storing the collected topology information in a storage section using Open Shortest Path First-Traffic Engineering (OSPF-TE) as a routing protocol;

        a section for signaling so as to establish/release optical paths using Border Gateway Protocol (BGP);

        a section for notifying route information to other optical edge routers which face the optical edge router; and

a section for reading out the routing table and the topology information from the storage section and producing packet forwarding tables which set to where the packets are to be transmitted in the section for transmitting the packets.

5.   (Currently Amended)   A computer program, embedded in a computer readable medium, used for optical networks and optical edge routers having sections for predetermined calculations and sections for transmitting packets between the section for predetermined calculations and external IP networks, wherein the section for the predetermined calculations comprises functions of:

exchanging route information between neighboring routers in the external IP networks;

producing a routing table and storing the produced routing table in a storage section;

collecting topology information inside the optical networks and storing the collected topology information in the storage section using Open Shortest Path First-Traffic Engineering (OSPF-TE) as a routing protocol;

signaling so as to establish/release the optical paths using Border Gateway Protocol (BGP);

notifying route information to other optical edge routers which face the optical edge router; and

reading out the routing tables and the topology information from the storage sections and producing a packet forwarding table which sets where the packets are to be transmitted to by the section for transmitting the packets.

6.   (Currently Amended) A cutting-through method for direct communication by a plurality of edge routers for connecting a core network and a plurality of external IP networks mutually at border points of the core network and the external IP networks, comprising:

maintaining lists, in which ingress-side IP address correspond to identifiers for showing outgoing interfaces of egress edge routers, in ingress edge routers;

adding the identifiers corresponding to the ingress-side IP address to the IP packets by the ingress edge routers when IP packets are transmitted;

transmitting the IP packets to the outgoing interfaces by referring to the identifiers added to the IP packets in the egress edge routers, wherein Generalized Multi-Protocol Label Switching (GMPLS) labels are used for the identifiers and the core network and the external IP networks are optical networks in which edge routers are connected directly by optical paths.

7.   (Cancelled)

8.   (Original)   A cutting-through method according to Claim 6 wherein correspondence information with respect to the ingress-side IP address and its corresponding identifiers are exchanged among the edge routers by control signals.

9.   (Currently Amended) An edge router comprising:

inputting sections for connecting a core network and a plurality of external IP networks at border points mutually and handling incoming IP packets, inputted from the external IP networks, to the core network; and

outputting sections for handling outgoing IP packets outputted from the core network to the external IP networks, wherein

the inputting sections has:

a section for maintaining lists, in which ingress-side IP addresses correspond to identifiers for showing outgoing interfaces of other egress edge routers; and

a section for adding the identifiers corresponding to the ingress-side IP addresses of the IP packets to the IP packets, in accordance with the lists when the IP packets are transmitted to other edge routers, and

the outputting section has a section for referring to the identifiers and transmitting the IP packets to the outgoing interfaces, indicated by the identifiers, wherein Generalized Multi-Protocol Label Switching (GMPLS) labels are used for the identifiers and

the core network and the external IP networks are optical networks in which edge routers are connected directly by optical paths.

10.   (Cancelled)

11.   (Original)   An edge router according to Claim 9, further comprising a section for exchanging information, in which the ingress-side IP addresses correspond

to the identifiers, among other edge routers mutually by control signals, and wherein the section for maintaining the lists has a section for generating or updating the lists in accordance with the information obtained by the exchanging section with respect to the correspondence information between the ingress-side IP addresses and the identifiers.

12.   (Currently Amended)   A computer program, embedded in a computer readable medium, installed to an information processing apparatus, for realizing functions corresponding to edge routers, the functions being inputting functions, for connecting a core network and a plurality of external IP networks at border points mutually and handling incoming IP packets inputted from the external IP networks to the core network; and outputting functions, for handling outgoing IP packets outputted from the core network to the external IP networks, wherein,

the inputting functions serve for:

a function for maintaining lists in which ingress-side IP addresses correspond to identifiers for showing outgoing interfaces of other egress edge routers; and

a function for adding the identifiers corresponding to the ingress-side IP addresses of the IP packets to the IP packets in accordance with the lists when the IP packets are transmitted to other edge routers, and

the outputting function serves for referring to the identifiers and transmitting the IP packets, indicated by the identifiers, to the outgoing interfaces, wherein Generalized Multi-Protocol Label Switching (GMPLS) labels are used for the identifiers and

the core network and the external IP networks are optical networks in which edge routers are connected directly by optical paths.

13.   (Cancelled)

14.   (Previously Presented) A computer program, embedded in a computer readable medium, according to Claim 12 further comprising a function for exchanging information, in which the ingress-side IP addresses correspond to the identifiers, among other edge routers mutually by control signals, and wherein the function for maintaining the lists serves for generating or updating the lists in accordance with the information obtained by the exchanging section with respect to the correspondence information between the ingress-side IP addresses and the identifiers.

15.   (Previously Presented) A recording medium, readable by the information processing apparatus, on which the computer program, embedded in a computer readable medium, according to Claim 12 is recorded.

16.   (Currently Amended) An information transmission network system, having a plurality of line exchangers and a plurality of packet exchangers, for setting communication lines among the packet exchangers, the line exchangers and the packet exchangers being connected by communication lines, wherein,

the line exchangers have a line switch and a section for controlling line paths;

the line switch has a function for connecting the communication lines, connected to the line exchangers, arbitrarily;

each of the packet exchangers, connected to the line exchangers, has a packet switch, a section for controlling line paths, a section for controlling packet paths, and a cooperative control section;

the packet switch has functions for selecting communication lines for transmission and outputting in accordance with packet-ingress-side's information transmitted via the communication lines;

the sections for controlling line paths in the line exchangers are connected to the sections for controlling line paths in other line exchangers via lines the among line exchangers;

the sections for controlling line paths in the packet exchangers are connected to at least the sections for controlling line paths in the line exchangers via lines among the packet exchangers and the line exchangers;

the sections for controlling line paths in the line exchangers and the sections for controlling line paths in the packet exchangers have a function for acknowledging line connection conditions in a communication network, by exchanging information of the communication conditions among the communication lines;

the section for controlling packet paths acknowledges connection-related-information with respect to packet exchange among the packet exchangers connected via the communication lines, by exchanging the information for the packet paths via the communication lines, and determines the communication lines for output in accordance with the packet-ingress-side's information;

the cooperative control sections have functions for receiving instructions regarding new communication lines, referring to two pieces of connection information, with respect to line-exchanging-network, collected by the section for controlling line paths, and connection information with respect to packet-exchange collected by the section for controlling packet paths, selecting paths, being used for the new communication lines, and instructing the section for controlling line paths to set paths being used for the new communication lines; and

the section for controlling line paths has functions for transmitting messages to the line exchangers to set up lines in accordance with the instructed paths so that the line exchangers, receiving the messages for controlling and setting the connected lines, set up the communication lines, and sending control messages to the line exchangers for setting the lines in accordance with the instructed paths, wherein the communication lines are Multi-Protocol Label Switching-Label Switch Path (MPLS-LSP) lines or optical lines, and Open Shortest Path First-Traffic Engineering (OSPF-TE) or Private Network-Network Interface (PNNI) is used as a communication protocol for the communication lines.

17.   (Original) An information transmission network system according to Claim 16, for setting the communication lines among the packet exchangers and packet/line exchangers, having packet/line exchangers in which the packet exchangers and the line exchangers are integrated.

18.   (Currently Amended) A packet exchanger in an information transmission network system, having a plurality of line exchangers and a plurality of packet exchangers, for setting communication lines among the packet exchangers, comprising:

a packet switch having a function for selecting communication lines used for transmittance, in accordance with packet-ingress-side's information transmitted by the communication lines and outputting;

at least one section for controlling line paths in the line exchangers, connected to the communication lines among the packet exchangers/line exchangers, for exchanging connection information of the communication lines and acknowledging line connection condition in a communication network;

a section for controlling packet paths having functions for acknowledging connection-related-information with respect to packet exchange by exchanging information of the packet paths via the communication lines among the packet exchangers connected via the communication lines, and determining the communication lines for output; and

a cooperative control section having a function for receiving instructions by new communication lines, referring to two pieces of connection information, with respect to the packet exchange, collected by the section for controlling line paths, and connection information with respect to the packet exchange collected by the section for controlling packet paths, selecting paths used for the new communication lines, and instructing the section for controlling line paths to set paths used for the new communication lines; wherein

the section for controlling line paths have functions for transmitting messages to the line exchangers to set up lines in accordance with the instructed paths so that the line exchangers receive the messages for controlling and setting the connected lines, set up the communication lines, and send control messages to the line exchangers for setting the lines in accordance with the instructed paths, wherein the communication lines are Multi-Protocol Label Switching-Label Switch Path (MPLS-LSP) lines or optical lines, and Open Shortest Path First-Traffic Engineering (OSPF-TE) or Private Network-Network Interface (PNNI) is used as a communication protocol for the communication lines.

19.   (Currently Amended)   A packet/line exchanger in an information transmission network system, having a plurality of line exchangers and a plurality of packet exchangers, for setting communication lines among the packet exchangers, comprising:

line switches, connected to the line exchangers, having a function for connecting the communication lines arbitrarily;

a packet switch having function for selecting communication lines used for transmittance, in accordance with packet-ingress-side's information transmitted by the communication lines and outputting the same;

at least a section for controlling line paths in the line exchangers, connected to the communication lines among the packet exchangers/line exchangers, for exchanging connection information of the communication lines and acknowledging line connection conditions in a communication network;

a section for controlling packet paths having functions for acknowledging connection-related-information with respect to packet exchange by exchanging information of the packet paths via the communication lines among the packet exchangers connected via the communication lines, and determining a communication line for output; and

a cooperative control section having a function for receiving instructions by new communication lines, referring to two pieces of connection information, with respect to the packet exchange, collected by the section for controlling line paths, and connection information with respect to the packet exchange collected by the section for controlling packet paths, selecting paths used for the new communication lines, and instructing the section for controlling line paths to set paths being used for the new communication lines; wherein

the section for controlling line paths has functions for transmitting messages to the line exchangers to set up lines in accordance with the instructed path, instructed by the cooperative control section, so that the line exchangers, receive the messages for controlling and setting the connected lines, set up the communication lines, and send control messages to the line exchangers for setting the lines in accordance with the instructed paths, wherein the communication lines are Multi-Protocol Label Switching-Label Switch Path (MPLS-LSP) lines or optical lines, and Open Shortest Path First-Traffic Engineering (OSPF-TE) or Private Network-Network Interface (PNNI) is used as a communication protocol for the communication lines.